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INSTRUCTION MANUAL

N CARRIER GENERATOR MODEL 322A

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N CARRIER GENERATOR
MODEL 322A

151 - 225

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TABLE OF CONTENTS

		Page
Section I.	GENERAL	
	A. PURPOSE	1-2
	B. DESCRIPTION	1-2
	C. SPECIFICATIONS	1-3
Section II.	OPERATION	
	A. CONTROLS AND INDICATORS	2-1
	B. PREPARATION FOR USE	2-2
	C. OPERATING PROCEDURE	2-3
	OPERATION AS TERMINATED SOURCE	2-3
	OPERATION AS BRIDGING SOURCE	2-5
	D. BATTERY POWER OPERATION	2-6
Section III.	THEORY OF OPERATION	
	A. INTRODUCTION	3-1
	B. FUNCTIONAL DESCRIPTION	3-2
	OSCILLATOR ASSEMBLY, A1	3-3
	SLOPE NETWORK ASSEMBLY, A2	3-3
	MODULATOR, OUTPUT AMPLIFIER, AND POWER SUPPLY REGULATOR ASSEMBLY, A3	3-4
	LEVEL AMPLIFIER ASSEMBLY, A4	3-4
	OUTPUT ATTENUATOR	3-5

Section IV. MAINTENANCE Page

A. GENERAL 4-1

B. INSPECTION AND ADJUSTMENT 4-1

TEST EQUIPMENT REQUIRED 4-1

INSPECTION 4-1

ADJUSTMENT AND ALIGNMENT 4-2

Oscillator Alignment 4-2
Output Current Adjustment 4-3
Output Power Calibration and Attenuator Check . . . 4-3
High Group Response Flatness Test 4-4
Low Group Response Flatness Test 4-5
Harmonic Distortion 4-5
Slope Network Test 4-5
Output Wiring Leakage Test 4-6
Selector Switch Wiring Test 4-7

Section V. REPLACEABLE PARTS LIST 5-1

LIST OF FIGURES

Figure Page

1-1 N Carrier Generator Model 322A 1-1

3-1 Block Diagram, N Carrier Generator Model 322A 3-6

4-1 Model 322A N Carrier Generator Schematic Diagram 4-8

LIST OF TABLES

Table		Page
2-1	Sierra N Carrier Generator Controls and Indicators	2-1
2-2	Carrier Output Levels - High Group Transmit	2-4
2-3	Typical Output Levels	2-4
2-4	Carrier Output Levels - Low Group Transmit	2-6
2-5	Typical "D" Cell Life (165 mA Load)	2-7
3-1	Frequency Allocations of N-Type Carrier Systems	3-2

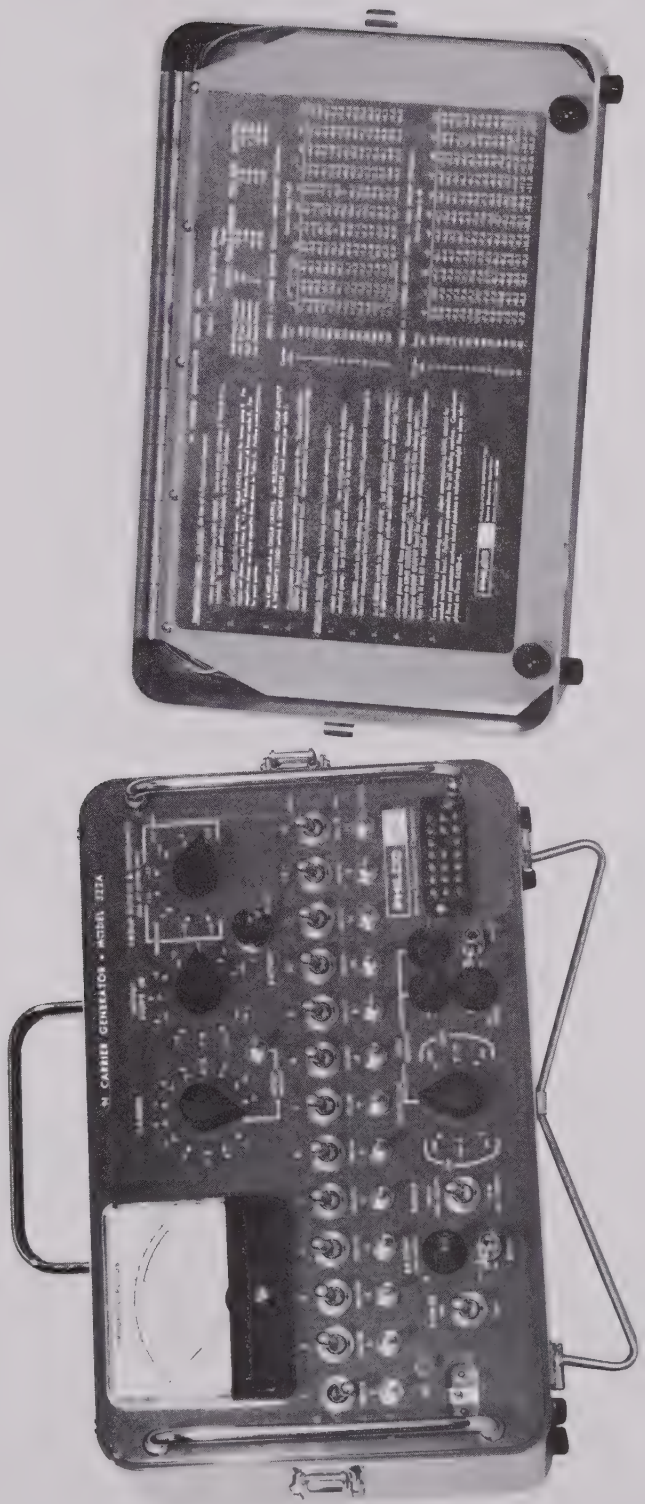


Figure 1-1. N Carrier Generator Model 322A

SECTION I
GENERAL

A. PURPOSE

The N Carrier Generator Model 322A is a portable, solid state device which produces a simulated high or low group carrier for testing various parts of type N carrier systems, and provides a reference standard for checking the calibration of the Sierra N Line Deviation Test Set KS-19750/Model 321A and the N Slope Test Set Model 320B. This carrier group consists of 13 independently adjustable crystal controlled frequencies which are combined to provide any needed combination of carriers, slopes, and levels.

The Generator may be used to supply a High or Low Group carrier in place of a terminal. In this application the generator output is adjusted for the usual combination of carriers 2 through 13, and is set to provide a matched, balanced 135 ohm source to the line. With this standard carrier present the line deviations may be measured and adjusted by using the Sierra N Line Deviation Test Set KS-19750/Model 321A. Used with the Sierra N Slope Test Set Model 320B or with the Sierra Frequency Selective Voltmeter KS-15538 L5A or its equivalent the actual repeatered line transmitted and received levels, as well as the crosstalk and noise in the system may be observed.

In addition, the Generator will supply missing carriers in a partially equipped system in order to make meaningful line deviation measurements. The output circuits of the Generator are set for bridging in parallel with an operating line, and since the output impedance is more than 800 ohms, a negligible system level reduction will result.

B. DESCRIPTION

The N Carrier Generator Model 322A (Figure 1-1) is a compact, portable, solid state device designed for office and field operation. It may be powered from a 115/230v ac ±20%, 50-60 Hz source, cover-contained "D" size flashlight cells, external dry cells, or from a 12 volt automotive storage battery.

The panel controls are protected by a detachable cover. This cover contains an operating instruction plate, a power cord storage compartment, and a storage compartment for 12 "D" size flashlight cells.

C. SPECIFICATIONS

OUTPUT FREQUENCIES

High Group

Carrier	Freq. kHz	Carrier	Freq. kHz
1	168	8	224
2	176	9	232
3	184	10	240
4	192	11	248
5	200	12	256
6	208	13	264
7	216		

Low Group

Carrier	Freq. kHz	Carrier	Freq. kHz
1	136	8	80
2	128	9	72
3	120	10	64
4	112	11	56
5	104	12	48
6	96	13	40
7	88		

Frequency Accuracy — Within ±20 Hz of assigned frequencies.

OUTPUT

Metering

Metered Ranges
0 to +16 dBm
-10 to +6 dBm
-45 to -29 dBm
-55 to -39 dBm

Meter Scales - Output dB -10 to +6 dB
Carriers -2 to +2 dB

Level Accuracy (12 Carriers-referenced to Thermocouple Detector)

Output Scale	
0 to +6 dB	±0.5 dB
-5 to 0 dB	±0.7 dB

Output Scale (Continued)	
-10 to -5 dB	±1.0 dB
Carriers Scale	±0.1 dB
Output Impedance (Balanced Output)	
Terminated Mode (135Ω Load)	135 ohms ±5%
Bridging Mode (Gen. Load is Parallel Combination of 135Ω Source and Load)	Bridging Loss 1 dB maximum
Output Stability (For Constant Load)	
Level	±0.4 dB maximum change due to all temperature and input power variations.
Deviations	0.25 dB maximum change in slope, bulge, cubic or quartic deviation due to temperature variations.
Spurious Outputs	
High Group	More than 26 dB down
Low Group	More than 26 dB down

SLOPE

Slope Network Steps	0, ±3, ±6, ±7, ±9 and ±10 dB steps
Step Accuracy	±0.25 dB

CONNECTORS

Twenty Pin Male	
Type	Equivalent to KS-14160 L1
Mates With	WECO W20C and W20D Cords
Selects	Output and Input Connections
	West to East
	East to West
	Group

CONNECTORS (Continued)

Binding Posts

Line (Generator Output)	Banana Jacks
DC Feed (Line Center Tap)	Banana Jack (Maximum input 205 mA and 200 VDC)
Battery Power	Banana Jacks

INPUT POWER

AC Voltage	115/230V AC ±20%
Power (Approx.)	5 watts
Frequency	50-60 Hz
Battery Voltage	10 to 18 Volts DC
Current (maximum)	200 mA

ENVIRONMENT

Storage	-40 to +60°C
Operation	
Within all Specifications	0 to +50°C (+32 to +122°F)
With Reduced Frequency and Level Accuracy	-10 to +60°C (+14 to +140°F)

SIZE (Approximate)*

Width	12-3/4 Inches
Height	9-3/4 Inches
Depth	9 Inches

WEIGHT 14 lbs.

COLORS - BAKED ENAMEL*

Case & Cover	Western Electric Light Gray #525A
Panel	Western Electric Dark Gray #586
Silkscreening	White

*Matches Sierra N Line Deviation Test Set KS-19750 L2

SECTION II
OPERATION

A. CONTROLS AND INDICATORS

The functions of the controls and displays required for the operation of the N Carrier Generator Model 322A, illustrated in Figure 1-1, are briefly described in Table 2-1 and amplified in Section III.

TABLE 2-1. Sierra N Carrier Generator Controls and Indicators

CONTROL or INDICATOR	FUNCTION	SCHEMATIC REFERENCE
115/230 Volt Switch (Inside left side of case)	Two position slide switch permits operation on 115 or 230V AC.	S15
POWER Switch	Controls AC or battery power to the Generator.	S18
AC Indicator	Lights when AC power is utilized and made available to the Generator.	DS-1
GROUP Switch	Selects HIGH 168-264 kHz or LOW 40-136 kHz output.	S17
Carrier Select Switches	When placed in ON, power applied to selected oscillator.	S1-S13
LEVEL Potentiometers	Used to adjust the output level of the selected oscillators.	R1-R13
CARRIER Level Switch	Selects carriers 1-13 or GROUP OUTPUT for display on dB meter.	S16
OUTPUT SLOPE DB Switch	Selects plus or minus 10, 9, 7, 6, 3, or 0 dB output slopes.	S14
GROUP OUTPUT Potentiometer	Used to adjust the composite carrier output level.	R14

TABLE 2-1. Sierra N Carrier Generator Controls and Indicators (Continued)

CONTROL or INDICATOR	FUNCTION	SCHEMATIC REFERENCE
DB Meter	Indicates individual and composite carrier output levels. Also indicates the status of batteries and the adequacy of the AC input.	M1
GROUP OUTPUT & IMPEDANCE, dBm AT METER ZERO Switch	Selects output power of -45, -35, 0, or +10 dBm in either the BRIDGING or 135 OHM modes when DB Meter reads 0 dB.	S20
SELECTOR Switch	Selects output circuits of 20 pin connector.	S21
BATTERY TEST Switch	Tests the adequacy of the batteries and also the input AC voltage.	S19

B. PREPARATION FOR USE

To prepare the Sierra N Carrier Generator Model 322A for use,

1. Remove the Generator from its packing box;

2. Connect to a 115/230 V AC, 50-60 Hz or a battery power source;

CAUTION

The internal 115/230 Volt Switch (S15) is normally factory set for 115 V AC operation. For 230 V AC operation insure that this switch position is changed prior to proceeding with operation.

3. Position POWER switch to ON;

4. Insure that AC indicator lights. If AC indicator fails to light, or if battery power is being used, depress BATTERY TEST switch and check indication on DB meter.

5. Proceed with operating procedure.

C. OPERATING PROCEDURE

Operating instructions for the Sierra N Carrier Generator Model 322A will also be found in the Generator's detachable cover (Figure 1-1). The Generator may be used as a terminated source in lieu of a terminal or repeater, or as a bridging source to supply missing carriers in a partially filled system.

OPERATION AS TERMINATED SOURCE

NOTE

When supplying a reference signal for the calibration of Sierra N Line Deviation Test Sets or Sierra N Slope Test Sets, the Generator LINE terminals must be terminated with a 135 ohm resistor. Failure to do this will result in high GROUP OUTPUT meter readings.

During extended operations an unused carrier position should be selected on the CARRIER level switch to deactivate the DB meter.

The Generator may be operated with the cover attached and closed by routing the power and output leads through the notches in the cover's rim.

1. Select HIGH or LOW position with GROUP switch. Position carrier select switches 1-12 or 2-13 to ON as required. Set OUTPUT SLOPE DB switch as required, or to next lower slope.

2. Position CARRIER level switch to first selected carrier. Adjust selected carrier LEVEL potentiometer to obtain 0 on DB meter lower scale. For slopes not shown use Table 2-2 or Table II in the Generator cover, +1 or +2 columns to obtain lower scale settings. For negative slopes use signs opposite to those shown in tables. Make similar adjustment for each selected carrier.

3. Set CARRIER level switch to GROUP OUTPUT. Position SELECTOR switch, GROUP OUTPUT & IMPEDANCE,dBm AT METER ZERO (135 OHM mode) switch, and GROUP OUTPUT potentiometer in accordance with levels shown in Table 2-3 or in the instructions (Table I) contained in the Generator cover.

4. Connect proper cord from Generator output to repeater or line. Readjust GROUP OUTPUT potentiometer to required level. Apply repeatered line power to DC FEED terminal if required.

TABLE 2-2. Carrier Output Levels - High Group Transmit

Carrier No.	Freq. KC	Carrier Slope In dB										
		0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
1	168	+1.2	+0.6	-0.1	-0.7	-1.4	-2.1	-2.8	-3.4	-4.0	-4.5	-5.0
2	176	+1.2	+0.7	+0.1	-0.5	-1.0	-1.6	-2.2	-2.8	-3.2	-3.6	-4.0
3	184	+1.2	+0.8	+0.3	-0.2	-0.7	-1.1	-1.6	-2.1	-2.5	-2.8	-3.1
4	192	+1.2	+0.9	+0.6	+0.1	-0.3	-0.7	-1.1	-1.5	-1.8	-2.0	-2.2
5	200	+1.2	+1.0	+0.8	+0.4	0	-0.3	-0.6	-0.9	-1.1	-1.2	-1.3
6	208	+1.2	+1.1	+0.9	+0.6	+0.4	+0.2	0	-0.2	-0.4	-0.4	-0.4
7	216	+1.2	+1.1	+1.1	+0.9	+0.8	+0.6	+0.5	+0.4	+0.3	+0.4	+0.5
8	224	+1.2	+1.2	+1.2	+1.2	+1.1	+1.1	+1.1	+1.1	+1.0	+1.2	+1.4
9	232	+1.2	+1.3	+1.4	+1.5	+1.5	+1.6	+1.6	+1.7	+1.7	+2.0	+2.3
10	240	+1.2	+1.4	+1.6	+1.8	+1.9	+2.1	+2.2	+2.3	+2.4	+2.8	+3.2
11	248	+1.2	+1.5	+1.8	+2.0	+2.2	+2.5	+2.7	+2.9	+3.1	+3.6	+4.1
12	256	+1.2	+1.6	+1.9	+2.3	+2.6	+2.9	+3.2	+3.6	+4.0	+4.5	+5.0
13	264	+1.2	+1.7	+2.1	+2.5	+3.0	+3.4	+3.8	+4.2	+4.8	+5.4	+6.0

TABLE 2-3. Typical Output Levels

	Selector	Group Output & Impedance	Meter Reads	Line Power
High Group Transmit	Out	+10 dB	+2 dB	+12 dBm
Low Group Transmit	Out	0 dB	+3 dB	+ 3 dBm
High Group Receive	In	-45 dB	+1 dB	-44 dBm
Low Group Receive	In	-35 dB	0 dB	-35 dBm

OPERATION AS BRIDGING SOURCE

NOTE

When the Generator is operated bridged on an operating system, the DB meter will read the approximate sum of the line power and the Generator power with the GROUP OUTPUT & IMPEDANCE, dBm AT METER ZERO (BRIDGING mode) switch in the 0 and +10 dB positions.

1. Select HIGH or LOW position with GROUP switch. Position carrier select switches 1-12 or 2-13 to ON as necessary to complete system. Set OUTPUT SLOPE DB switch as required, or to next lower slope.

2. Position CARRIER level switch to first selected carrier. Adjust selected carrier LEVEL potentiometer to obtain 0 on DB meter lower scale. Make similar adjustments for each selected (added) carrier.

3. Set CARRIER level switch to GROUP OUTPUT. Position SELECTOR switch, GROUP OUTPUT & IMPEDANCE, dBm AT METER ZERO (BRIDGING mode) switch, and GROUP OUTPUT potentiometer in accordance with levels shown in Table 2-3 or in the instructions (Table 1) contained in the Generator cover.

4. Connect proper cord from Generator output to repeater or line. Connect selective voltmeter to LINE OUTPUT terminals. Tune voltmeter to first added carrier. Readjust GROUP OUTPUT potentiometer to obtain voltmeter reading corresponding to those found in Table 2-2 and Table 2-4 (Tables II and III in Generator cover).

5. Tune voltmeter to next selected carrier. Adjust corresponding carrier LEVEL potentiometer to obtain needed voltmeter level. Make similar adjustments for each missing carrier. Combination of line and Generator carriers should produce a relatively straight line slope when plotted on Bell System Practice Form E4558-6. To average level of the added carriers may be further adjusted to match with the GROUP OUTPUT potentiometer.

TABLE 2-4. Carrier Output Levels - Low Group Transmit

Carrier No.	Freq. KC	Carrier Slope In dB 0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10
1	136	-7.8	-7.2	-6.6	-6.1	-5.6	-5.1	-4.6	-4.2	-3.8	-3.4	-3.0
2	128	-7.8	-7.3	-6.8	-6.4	-6.0	-5.6	-5.2	-4.8	-4.6	-4.3	-4.0
3	120	-7.8	-7.4	-7.0	-6.7	-6.3	-6.0	-5.7	-5.4	-5.3	-5.1	-4.9
4	112	-7.8	-7.5	-7.2	-7.0	-6.7	-6.5	-6.3	-6.1	-6.0	-5.9	-5.8
5	104	-7.8	-7.6	-7.4	-7.2	-7.1	-6.9	-6.8	-6.7	-6.7	-6.7	-6.7
6	96	-7.8	-7.7	-7.6	-7.5	-7.4	-7.4	-7.3	-7.3	-7.4	-7.5	-7.6
7	88	-7.8	-7.7	-7.8	-7.8	-7.8	-7.8	-7.9	-8.0	-8.2	-8.3	-8.5
8	80	-7.8	-7.8	-7.9	-8.0	-8.1	-8.3	-8.4	-8.6	-8.9	-9.1	-9.4
9	72	-7.8	-7.9	-8.1	-8.3	-8.5	-8.7	-9.0	-9.2	-9.6	-9.9	-10.3
10	64	-7.8	-8.0	-8.3	-8.6	-8.9	-9.2	-9.5	-9.9	-10.3	-10.8	-11.2
11	56	-7.8	-8.1	-8.5	-8.8	-9.2	-9.6	-10.0	-10.5	-11.0	-11.6	-12.1
12	48	-7.8	-8.2	-8.6	-9.1	-9.6	-10.1	-10.6	-11.2	-11.8	-12.4	-13.0
13	40	-7.8	-8.3	-8.8	-9.4	-10.0	-10.6	-11.2	-11.8	-12.6	-13.3	-14.0

D. BATTERY POWER OPERATION

The Sierra N Carrier Generator Model 322A may be operated from a variety of battery sources. The Generator cover contains clips for 12 "D" size flashlight cells which initially produce +18 volts dc. As minimum useable voltage is 9-10 volts, the REPLACE BATTERIES zone on the db meter represents the availability of less than 10 volts dc.

Battery life is dependent upon current requirements of the Generator, which is a function of the number of oscillators energized and the time per day usage. Some typical current requirements are:

13 carriers, LOW group, +16 dBm output	200 mA
12 carriers, HIGH group, +12 dBm output	165 mA
12 carriers, LOW group, +3 dBm output	165 mA
6 carriers, HIGH group	85 mA
1 carrier, HIGH group	32 mA

Using 12 "D" size cells with a 165 mA load at 70°F, battery life will be approximately as shown in Table 2-5.

NOTE

Transistor radio batteries are not recommended for this current.

TABLE 2-5. Typical "D" Cell Life (165 mA Load)

TYPE	SERVICE	USAGE	LIFE (Hours)
Burgess #2	Flashlight	Continuous	22
Burgess #2	Flashlight	4 Hours/Day	25
Burgess #220	Industrial	Continuous	25
Burgess #220	Industrial	4 Hours/Day	40

Using 12 telephone dry cells (#6) or equivalent with a 165 mA load at 70°F, battery life should be approximately 240 hours with continuous use, and 290 hours if used only 4 hours each day.

The least expensive source for extended operation at a remote site is a 12 volt, lead acid, automotive battery. A fully charged, two year old, 68 ampere hour, group 24 battery will provide 9-10 days of continuous service. A new battery can be expected to provide about 16 days of service.

SECTION III
THEORY OF OPERATION

A. INTRODUCTION

In telephone company usage, cable carrier refers to the transmission of a number of conversations over a single pair of wires in a cable. Usually, 12 or 24 channels of audio information are simultaneously transmitted through the cable on a series of 12 carriers which are frequency-separated and individually modulated. Electrical separation of the signals is usually obtained by employing a cable pair for each direction of transmission, and further by using different frequency bands for each direction of transmission. In the N type system, transmission in one direction on one pair occupies frequencies from 40 to 136 kHz, and is known as "low group". Transmission in the opposite direction, on another pair, occupies frequencies from 168 kHz to 264 kHz, and is known as "high group". The channels are spaced 8 kHz. Table 3-1 shows the frequency allocations for N-type systems.

The N cable carrier systems use repeatered lines, in which repeaters are installed at nominal 5-mile intervals to maintain the signal characteristics. The repeaters are powered by direct current which is transmitted over the cable along with the carrier signal.

Compensation for increasing high-frequency transmission loss is obtained by modulating the high group to low group and low group to high group at each repeater. This is the technique known as "frogging". Since each group is the mirror image of the other, the effect of frequency-dependent transmission loss is minimized by frogging.

To help maintain consistent carrier levels, a graduated pre-emphasis, increasing with increasing frequency, is applied to each carrier. The highest frequency carrier would be set to a level about 7 dB above the lowest at the beginning of a 5-mile repeatered line section.

The N Carrier Generator Model 322A provides a source of all possible combinations of N carrier frequencies, levels, and groups commonly used to evaluate and equalize the N repeatered line. It may be used to supply a complete 12-carrier group, to provide missing carriers in a partially filed operating carrier system, and as a reference standard for checking the calibration of the Sierra N Line Deviation Test Set KS19750/Model 321A and the N Slope Test Set Model 320B.

The Generator may be operated as a high or low group transmit terminal or repeater with carriers 1-12 or 2-13 provided. The Generator output may also be internally attenuated to simulate the low level composite signal received at a repeater or terminal. In both high and low level and high and low group operation, dc line current may be supplied through the center tap connection provided in the Generator output. This terminated mode of operation provides a well-matched, balanced 135 ohm output.

TABLE 3-1. Frequency Allocations of N-Type Carrier Systems

Line Carrier Frequency, kHz			N1 Terminal	N2 Terminal	N3 Terminal		N3 Terminal	ON-2 Terminal	
No.	High Group	Low Group	Channel No.	Channel No.	Channel No.	Channel Grp.	Carrier No.	Carrier No.	
1	168	136	1	1					
2	176	128	2	2	1 2	1 1	1	1	grp. 1
3	184	120	3	3	3 4	1 1	2	2	
4	192	112	4	4	5 6	1 1	3	3	grp. 2
5	200	104	5	5	7 8	1 1	4	4	
6	208	96	6	6	9 10	1 1	5	5	grp. 3
7	216	88	7	7	11 12	1 1	6	6	
8	224	80	8	8	1 2	2 2	7	7	grp. 4
9	232	72	9	9	3 4	2 2	8	8	
10	240	64	10	10	5 6	2 2	9	9	grp. 5
11	248	56	11	11	7 8	2 2	10	10	
12	256	48	12	12	9 10	2 2	11	11	grp. 6
13	264	40	13	13	11 12	2 2	12	12	

When used to supply missing carriers in a partially filled operating carrier system, the Generator is bridged across the system, causing no more than 0.7 dB drop in the composite output level. The required carriers are then adjusted to the level which provides the desired slope at the point of bridging. No center tap dc feed is available or required for this mode of operation.

The generated carriers may be set to slopes of 0, ±3, ±6, ±7, ±9 and ±10 dB. An internal slope network is provided for this purpose. The panel mounted meter, in conjunction with tables of carrier levels contained in the cover of the instrument (Table 2-2 and Table 2-4 in Section II), permits the operator to set up slope values not available from the internal slope network.

B. FUNCTIONAL DESCRIPTION

The N Carrier Generator Model 322A consists of fourteen oscillators, a slope network, a modulator, a level amplifier, an output amplifier, and a power supply-regulator. See Block Diagram, Figure 3-1, and the Schematic Diagram included in the back of this manual for an illustration of the modular grouping of the functional components, and their interrelated signal flow. Each of these major assemblies is discussed below.

OSCILLATOR ASSEMBLY, A1

The oscillator assembly, A1, contains fourteen basically identical high group oscillator circuits. These vary only to the extent shown in the Schematic Diagram. Each oscillator circuit consists of a crystal oscillator and a tuned amplifier stage. The fixed crystal oscillator frequencies include the thirteen carrier frequencies and a 304 kHz low group modulation frequency. The frequencies are factory adjusted (at room temperature) to within -5 to +10 Hz of the carrier frequencies, and even with extreme fluctuations in temperature will vary only slightly in frequency (no more than ±20 Hz).

The second stage of the tuned amplifier is over-driven so that its output level does not change with oscillator activity. This feature makes the output level of all thirteen oscillator circuits dependent only on the power supply. Since a change in the relative level of any oscillator represents a change in the preset output slope, this guarantees a very stable preset slope or deviation. Differential level change, due to temperature cycling the oscillator circuit is less than 0.2 dB. The tuned amplifier also makes the oscillator output extremely harmonic free.

Each oscillator is energized by applying collector voltage to its circuit. The Carrier Select Switches (S1-S13) apply power to the selected oscillator when placed in the ON position so any combination of the thirteen high group frequencies may be selected. Low group frequencies are obtained by positioning the GROUP select switch to the LOW 40-136 kHz position, which energizes the 304 kHz oscillator and allows modulation of the high group frequencies to the low group frequencies.

The output of each carrier oscillator is applied to a panel mounted LEVEL potentiometer (R1-R13); a 25 turn unit which is operated by a small knurled shaft. The large number of turns permits fine level adjustment.

The output level from each potentiometer, prior to the summing network, can be sampled via the CARRIER level switch (S16). This permits the relative levels of all carriers to be set equal or in accordance with Table 2-2 (Table II in the Generator cover) for any desired slope or combination of line deviations. The output of each potentiometer is then applied to a precision resistive summing network, which combines all carriers activated to a single composite output. Precision resistors are used so that when all carrier levels are equated (flat slope), the output from the Generator will be flat. The output of the summing network is applied to the slope network assembly, A2.

SLOPE NETWORK ASSEMBLY, A2

The internally mounted slope network assembly, A2, provides selectable output slopes of 0, ±3, ±6, ±7, ±9, or ±10 dB, when all selected carriers are leveled to 0 dB on the DB meter, and the OUTPUT SLOPE DB switch (S14) is positioned to the required output slope. If some other slope is required, a lower level is selected with the OUTPUT SLOPE DB switch and the carrier levels are set in accordance with Table 2-2 (Table II in the Generator cover)

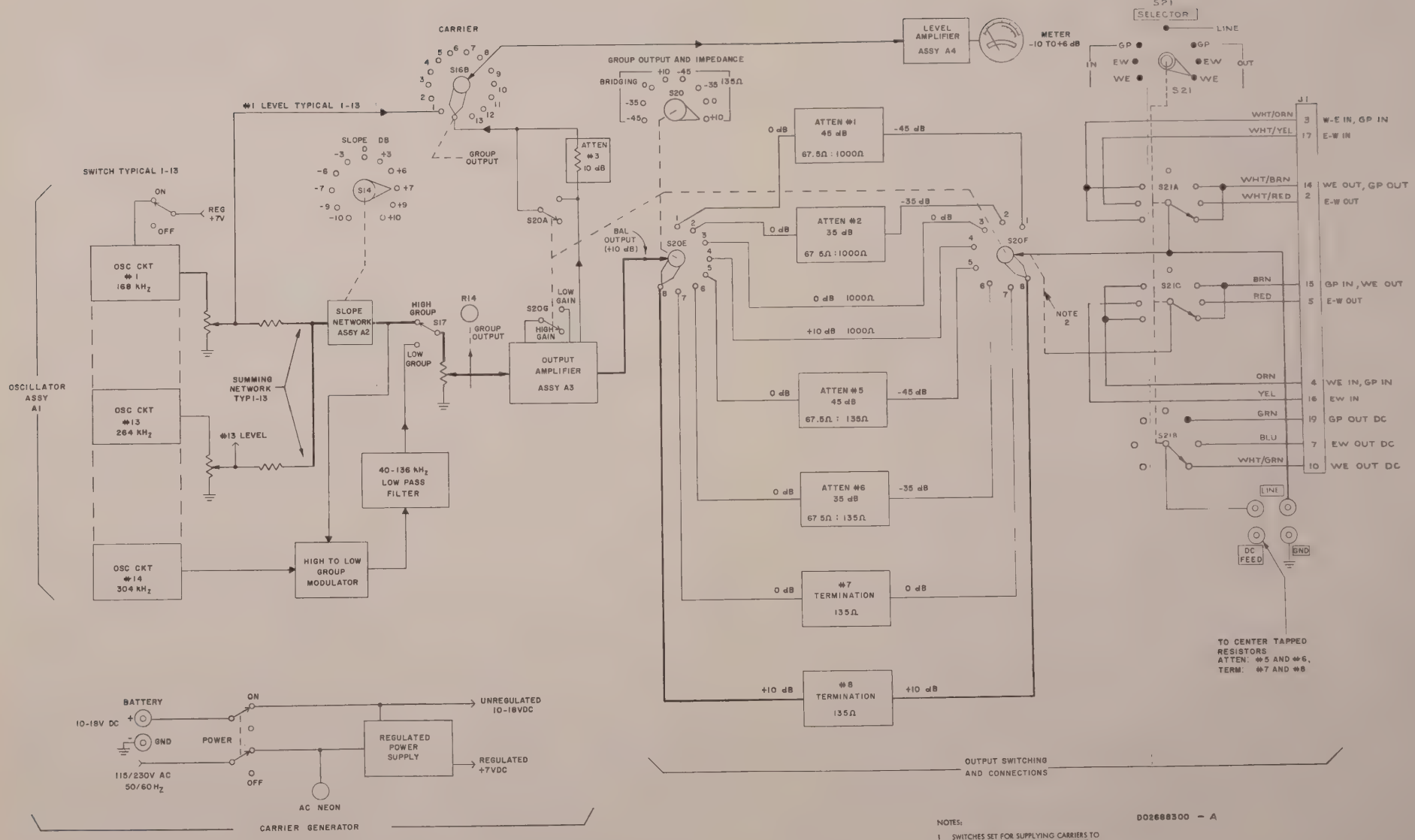
The BATTERY TEST switch (S19) applies the battery voltage to the meter when depressed.

OUTPUT ATTENUATOR

The GROUP OUTPUT & IMPEDANCE switch (S20) selects four output levels at two output impedances for bridging and terminating. The output amplifier is designed to drive a 67.5 ohm load and the level metering across its output is correct only for this load. With switch S20 in positions 3 and 4, the output transformer (T2) secondary is directly connected to the output terminals. This secondary provides a resistive shunt of more than 800 ohms across the circuit being bridged. The level circuit being bridged consists of a nominal 135 ohm source connected to a nominal 135 ohm load. This represents a 67.5 ohm load to the N Carrier Generator.

All other positions of the GROUP OUTPUT & IMPEDANCE switch present the output amplifier with this same 67.5 ohm load. The level change between the 0 dBm and the +10 dBm positions is affected by changing the loss in the level meter channel by 10 dB while raising the output amplifier gain 10 dB.

The output impedance of the N Carrier Generator is more than 800 ohms with no center tap connection for bridging. The output impedance is 135 ohms ±5% in the terminated mode over the frequency range of 40-264 kHz. The center tap connection is taken from a resistor center tap on all terminated 135 ohm positions. This eliminates significant unbalanced direct current in the output transformer and possible overheating of the attenuator resistors when 205 mA direct current is applied to the repeatered line.



NOTES:

1. SWITCHES SET FOR SUPPLYING CARRIERS TO REPLACE MISSING L-H REPEATER OUTPUT VIA W20C CORD.
2. FOR CLARITY ONLY ONE HALF OF BALANCED ATTENUATORS SHOWN.

Figure 3-1. Block Diagram, Model 322A N Carrier Generator

SECTION IV
MAINTENANCE

A. GENERAL

There is no regular maintenance to be performed on the Generator except to change the batteries whenever the Battery Check shows a meter reading in the REPLACE BATTERIES zone. Whenever the batteries are changed the contacts in the Battery Holder Assembly should be checked for signs of corrosion or accumulation of dirt.

If trouble is experienced the fault should be traced to a particular module and then point by point checks made to isolate a faulty component. A good understanding of the Theory of Operation as outlined in Section III will greatly aid in tracing the applied signal through the different modules. Additional information may be obtained by studying the Inspection and Adjustment procedure.

B. INSPECTION AND ADJUSTMENT PROCEDURE

TEST EQUIPMENT REQUIRED

1. Power Supply	HP 721A or equivalent (4 to 7 volts)
2. Electronic Counter	HP 5400 or equivalent
3. RMS AC Voltmeter	HP 3400
4. Selective Voltmeter	Sierra Model 125B or equivalent
5. Power Supply	HP 712B or equivalent (300 volts)
6. Neon Lamp	DIALCO 45H-33K 935
7. Neon Lamp Socket	DIALCO 7538-XP50
8. N Line Deviation Test Set	Sierra Model KS19750/321A

INSPECTION

Prior to the acceptance, the alignment, or the adjustment of this equipment, insure that the following preliminary adjustments are completed:

1. Verify that DB Meter is mechanically zeroed.

2. Verify that knobs are oriented to agree with silkscreen.

3. Turn all potentiometers full clockwise until they click (all potentiometers should turn freely).

ADJUSTMENT AND ALIGNMENT

NOTE

The removal of the four case screws will allow removal of the case and easy access to the Generator circuits.

OSCILLATOR ALIGNMENT

1. Connect counter to Generator LINE OUTPUT terminals.

2. Set GROUP OUTPUT & IMPEDANCE, dBm at METER ZERO switch to +10 dBm (135 OHM mode). Set CARRIER level switch to GROUP OUTPUT. Set OUTPUT DB SLOPE switch to 0 dB. Set GROUP switch to HIGH 168-264 kHz position.

3. Turn all 13 carrier select switches to OFF (Oscillator #14 is deenergized whenever the GROUP switch is in the HIGH 168-264 kHz position).

4. Apply 115 volt ac. With multimeter check and adjust power supply regulator for +7 volts. Measure the unregulated +15 volt ac input voltage. Operate the 115/230 volt ac switch (S15), and verify that the input voltage drops to approximately half in 230 volt ac. Reset the switch to the 115 volt position.

5. Connect a +4 volt supply to the suspected oscillator (negative to the chassis and positive to the B+ lug). Adjust inductor L3 for maximum output using the Generator dB meter. Next adjust inductor L4 for maximum output. Readjust inductor L3 as required for center of range of the oscillator. Verify that the oscillator starts as the power supply voltage is increased from 0 at approximately +3.8 volts. (The 304 kHz oscillator level must be observed by connecting an ac voltmeter directly to the oscillator's output terminals.)

6. Disconnect the power supply.

7. Turn on the suspected oscillators, one at a time, and measure that the frequencies are between 5 cycles low and 10 cycles high. If the frequencies are out of this tolerance, add a capacitor in parallel in the holes provided to lower the frequency; replace capacitor C1 with a smaller value to raise the frequency.

NOTE

The 304 kHz oscillator frequency must be adjusted to between ±5 Hz.

OUTPUT CURRENT ADJUSTMENT

1. Disconnect the power source from the Generator. Connect a HP 721A power supply to the Generator BATTERY terminals. Turn all carrier select switches to OFF. Position the GROUP switch to HIGH 168-264 kHz. Set the power supply for +15V dc. Adjust potentiometer R13 (Null 3F), Board A3, counterclockwise until the power supply current stops decreasing. Current should read approximately 23 mA.

2. Adjust potentiometer R13 clockwise until the current is 10 mA above this minimum value. This increase is being drawn by the output transistors.

3. Disconnect the power supply and reconnect the Generator to a power source.

OUTPUT POWER CALIBRATION AND ATTENUATOR CHECKS

1. Turn carrier select switches 2-13 to ON. Position the GROUP switch to HIGH 168-264 kHz. Position the CARRIER level switch to GROUP OUTPUT, and select 0 dBm (135 OHM mode) with the GROUP OUTPUT & IMPEDANCE switch. Connect a 135 ohm ±1% resistor and the HP 3400 rms voltmeter in parallel on the Generator LINE OUTPUT terminals. Adjust the GROUP OUTPUT potentiometer to obtain a reading of -6.6 dBm (600Ω) on the HP 3400. Adjust potentiometer R3, 0 dB CAL Control, on the A4 board assembly for a 0 dB reading on the dB meter top scale.

2. Set the CARRIER level switch to position 1, and turn carrier select switch #1 ON. The indicated level must be above full scale with the selected carrier level potentiometer in the full clockwise position. On the lower carrier level meter scale reduce the level to -2 dB and then bring back to 0. Insure that the potentiometer does not bind, and is free of intermittent steps over this ±2 dB range. Leave the level set at exactly 0 dB.

3. Repeat Step 2 for all carrier LEVEL potentiometers.

OUTPUT POWER CALIBRATION AND ATTENUATOR CHECKS (Continued)

4. Reset the CARRIER level switch to GROUP OUTPUT. Reset the GROUP OUTPUT & IMPEDANCE switch to 0 dBm (135 OHM mode). Readjust the GROUP OUTPUT potentiometer to obtain -6.6 dBm on the HP 3400. Reset R3, 0 dB CAL potentiometer, on Level Amplifier assembly A4 for a top scale reading of 0 dB.

5. Set GROUP OUTPUT & IMPEDANCE switch to +10 dBm (135 OHM mode). Readjust the GROUP OUTPUT potentiometer for a 0 dB top scale reading. Output on the HP 3400 voltmeter must now read -6.6 ±0.3 dB (+10 dB range). Set the GROUP OUTPUT & IMPEDANCE switch to -35 dBm (135 OHM mode), and insure that the HP 3400 reads -41.6 ±0.3 dBm. Finally, set the GROUP OUTPUT & IMPEDANCE switch to -45 dBm (135 OHM mode). The HP 3400 must read -51.6 ±0.3 dBm.

NOTE

With the GROUP OUTPUT & IMPEDANCE switch in the -35 or -45 dBm positions, all equipment must be grounded together to reduce hum pickup to below -65 dBm.

6. Connect a second 135 ohm ±1% resistor in parallel with the LINE OUTPUT terminals. Set the GROUP OUTPUT & IMPEDANCE switch to 0 dBm (BRIDGING mode). The HP 3400 must read -6.6 ±0.2 dBm. Reset the GROUP OUTPUT potentiometer for a -6.6 dBm reading. Set the GROUP OUTPUT & IMPEDANCE switch to +10 dBm (BRIDGING mode), and check HP 3400 for reading of -6.6 ±0.3 dBm (+10 dB range). Set the GROUP OUTPUT & IMPEDANCE Switch to -35 dBm and insure that the HP 3400 reads -41.6 ±0.3 dBm. Finally, set the GROUP OUTPUT & IMPEDANCE switch to -45 dBm. The HP 3400 must read -51.6 ±0.3 dBm.

HIGH GROUP RESPONSE FLATNESS TEST

1. Turn carrier #1 ON. Set GROUP select switch to HIGH 168-264 kHz. Set CARRIER level switch to #1. Set GROUP OUTPUT & IMPEDANCE switch to 0 dBm (135 OHM mode). Connect one 135 ohm resistor and the HP 3400 in parallel to the Generator LINE OUTPUT terminals. Adjust the #1 LEVEL potentiometer for exactly 0 dB on the lower meter scale. Adjust the GROUP OUTPUT potentiometer for a reading of exactly -20 dBm on the HP 3400. (This is now the reference level setting of the GROUP OUTPUT potentiometer. Do

HIGH GROUP RESPONSE FLATNESS TEST (Continued)

not change the GROUP OUTPUT potentiometer adjustment.)

2. Set the CARRIER level switch to #2. Adjust the #2 LEVEL potentiometer for exactly 0 dB on the lower meter scale. The HP 3400 must read -20 ±0.1 dB. Proceed through all LEVEL potentiometer in this manner. All 13 levels, one at a time, must be equal within 0.25 dB.

LOW GROUP RESPONSE FLATNESS TEST

1. Turn carrier #6 ON. Set GROUP select switch to LOW 40-136 kHz. Adjust the GROUP OUTPUT potentiometer for a -20.0 dBm reading on the HP 3400. Set the CARRIER level switch to GROUP OUTPUT. Turn on each low group carrier one at a time. The HP 3400 must show that all low group carriers are equal within 0.25 dB.

HARMONIC DISTORTION

1. Set the GROUP OUTPUT & IMPEDANCE switch to +10 dBm (135 OHM mode). Set GROUP select switch to HIGH 168-264 kHz. Set the OUTPUT SLOPE DB switch to 0 dB. Turn all 13 high group carriers ON. Tune the voltmeter to 264 kHz. Adjust the GROUP OUTPUT potentiometer to obtain 0 dBm on the voltmeter. (The voltmeter is to be calibrated, set for 135 ohm input, and for wide selectivity.) Next, set the voltmeter to -20 dBm, and tune from 270 to 620 kHz. All responses must be below -26 dBm.

2. Set the GROUP select switch to LOW 40-136 kHz. Tune the voltmeter from 140 to 620 kHz. All carriers shall be below -26 dBm. Check particularly the feed through frequencies (i.e., the 224 kHz, the 304 kHz, and the 608 kHz).

SLOPE NETWORK TEST

1. Connect the N Line Deviation Test Set and a 135 ohm resistor in parallel across the LINE OUTPUT terminals. Position carrier selects switches 2-13 to ON. Set GROUP select switch to HIGH 168-264 kHz. Set OUTPUT SLOPE DB switch to 0 dB, and the GROUP OUTPUT & IMPEDANCE switch to 0 dBm (135 OHM mode).

SLOPE NETWORK TEST (Continued)

2. Measure the output slope with the N Line Deviation Test Set. Slope should be less than ±0.2 dB. Adjust Test Set "S" potentiometer so that slope reads exactly zero. Measure generator slopes with Test Set in accordance with the instructions in the Test Set cover. All Generator slopes must be within ±0.25 dB of the step value on the Generator OUTPUT SLOPE DB switch.

3. Reset the OUTPUT SLOPE DB switch to 0 dB, and set the GROUP OUTPUT & IMPEDANCE switch to 10 dBm (135 OHM mode). Measure the output slope with the N Line Deivation Test Set. The slope must be 0 ±0.2 dB.

4. Reset GROUP OUTPUT & IMPEDANCE switch to 0 dBm (135 OHM mode), set GROUP select switch to LOW 40-136 kHz, and measure the output slope with the N Line Deviation Test Set. The slope must be 0 ±0.3 dB.

5. Turn the N Line Deviation Test Set OFF, and disconnect from the Generator.

OUTPUT WIRING LEAKAGE TEST

1. Connect one side of the neon lamp to the +300 volt power supply positive terminal. Connect the other side of the neon lamp to one of the LINE OUTPUT terminals. Connect the negative terminal of the power supply to chassis ground. Turn the power supply ON.

2. Operate the SELECTOR switch through all its positions. The neon light must not light.

3. Operate the GROUP OUTPUT & IMPEDANCE switch through all its positions. The neon lamp must not light.

4. Set the GROUP OUTPUT & IMPEDANCE switch to +10 dBm (135 OHM mode), and ground the DC FEED terminal. The neon light must light.

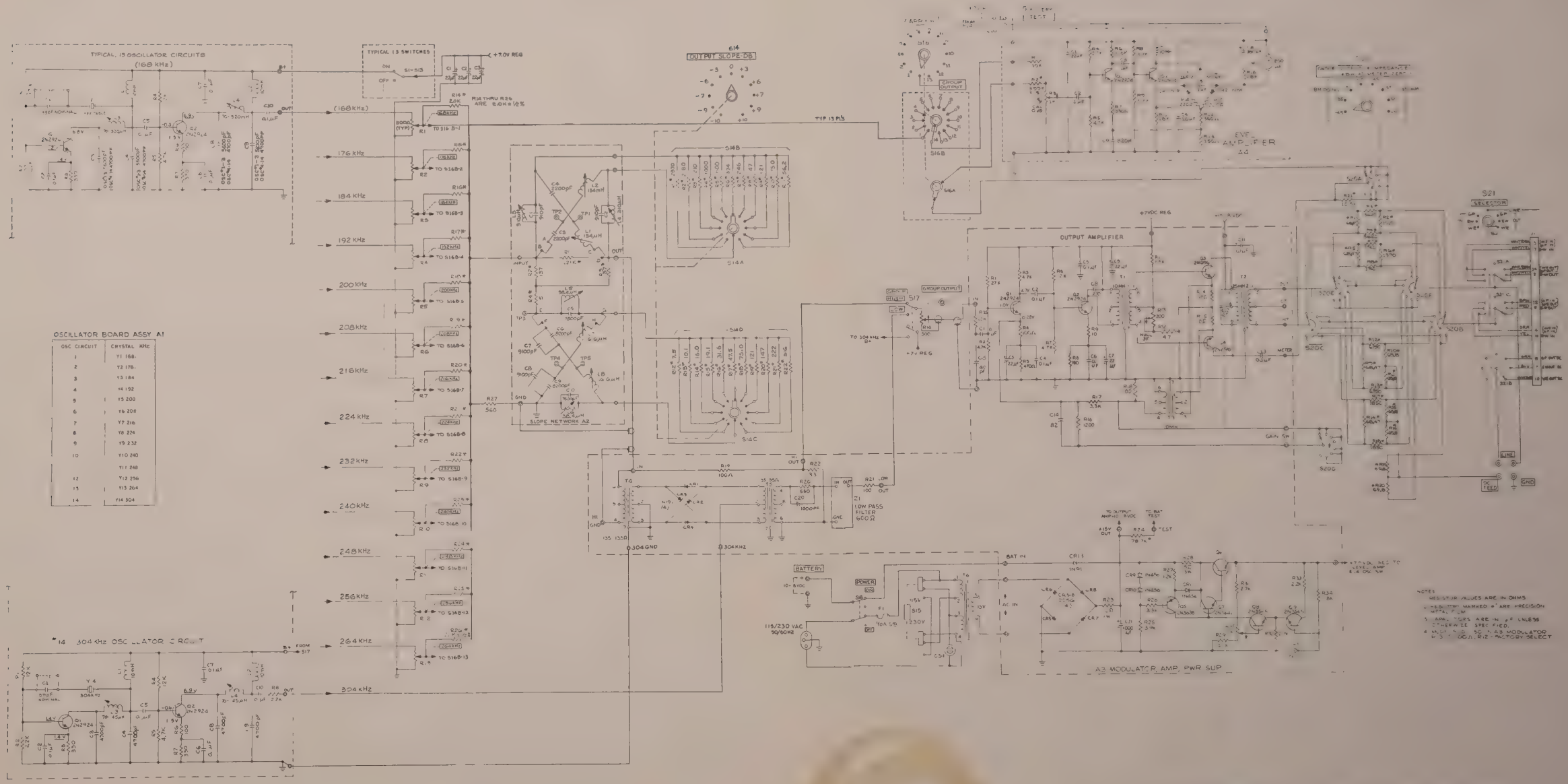
5. Disconnect 300 volt power supply and the neon lamp.

SELECTOR SWITCH WIRING TEST

1. Turn carrier select switches 1-13 ON. Set GROUP select switch to HIGH 168-264 kHz, and GROUP OUTPUT & IMPEDANCE switch to +10 dBm (135 OHM mode). Adjust the GROUP OUTPUT potentiometer for 0 dBm output.

2. As the following pairs of pins of the 20 pin connector are shorted together, the meter reading will drop to indicate wiring continuity through the SELECTOR switch.

SELECTOR Position		Short Pins
IN	WE	0 to 1
IN	EW	18 to 19
IN	GRP	3 to 4
OUT	GRP	14 to 15
OUT	EW	8 to 11
OUT	WE	9 to 12



Schematic Diagram, N Carrier Generator Model 322A

SECTION V
REPLACEABLE PARTS LIST

PARTS REPLACEMENT

Standard components have been used in this instrument whenever possible. Both standard and special components may be ordered direct from the factory.

When ordering parts always include:

1. Sierra Stock Number.
2. Circuit Reference and Commercial Description.
3. Name, Model and Serial Number of the instrument.

Parts for this instrument, or further service information may be obtained from:

SIERRA ELECTRONIC OPERATION
Philco-Ford Corporation
3885 Bohannon Drive
Menlo Park, California 94025

Telephone (415) 322-7222
TWX 910-373-1282

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	OSCILLATOR ASSEMBLY, A1				
C1	CAPACITOR, Mica, 39 pF ±2%, 500VDCW	901900390	El Menco	DM15-E390G	14
C2	CAPACITOR, Ceramic, 0.1 µF, +80 -20%, 50VDCW	901410104	Sprague	33C41	70
C3	FOR OSC. #1, 2 and 3 use:				
	CAPACITOR, Paper, .0056 µF, 600VDC	901100562	Arco	6DP-1-562	12
	FOR OSC. #4-14 use:				
	CAPACITOR, Paper, .0047 µF ±10%, 600V	901100472	Arco	6DP-1-472	44
C4	Same as C3				
C5	Same as C2				
C6	Same as C2				
C7	Same as C2				
C8	Same as C3				
C9	Same as C3				
C10	Same as C2				
L1	INDUCTOR, RF, 10 MH ±5%	909000134	Miller	70F102A1	28
L2	Same as L1				
L3	FOR OSC. #1-11 use:				
	INDUCTOR, Variable, 70-320 µH (120T, L560-3F		Sierra	A02367900	22
	FOR OSC. #12, 13 and 14 use: Green)				
	INDUCTOR, Variable, 70-145 µH (85T, L560-3F)		Sierra	A02368000 Red	6
L4	Same as L3				
Q1	TRANSISTOR, Silicon, NPN	910300029	Fairchild	2N2924	28
Q2	Same as Q1				
R1	RESISTOR, Composition, 12K ±5%, 1/4W	906900123	AB		28
R2	RESISTOR, Composition, 2.2K ±5%, 1/4W	906900222	AB		15
R3	RESISTOR, Composition, 330Ω ±5%, 1/4W	906900331	AB		28
R4	Same as R1				
R5	RESISTOR, Composition, 4.7K ±5%, 1/4W	906900472	AB		14
R6	RESISTOR, Composition, 100Ω ±5%, 1/4W	906900101	AB		14
R7	Same as R3				
R8	Same as R2				
Y1	CRYSTAL, Series Resonant, 168 kHz	912200042	Sierra	A02452500	1
Y2	CRYSTAL, Series Resonant, 176 kHz	912200043	Sierra	A02452500	1
Y3	CRYSTAL, Series Resonant, 184 kHz	912200044	Sierra	A02452500	1
Y4	CRYSTAL, Series Resonant, 192 kHz	912200045	Sierra	A02452500	1
Y5	CRYSTAL, Series Resonant, 200 kHz	912200046	Sierra	A02452500	1
Y6	CRYSTAL, Series Resonant, 208 kHz	912200047	Sierra	A02452500	1
Y7	CRYSTAL, Series Resonant, 216 kHz	912200048	Sierra	A02452500	1
Y8	CRYSTAL, Series Resonant, 224 kHz	912200049	Sierra	A02452500	1
Y9	CRYSTAL, Series Resonant, 232 kHz	912200050	Sierra	A02452500	1
Y10	CRYSTAL, Series Resonant, 240 kHz	912200051	Sierra	A02452500	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	OSCILLATOR ASSEMBLY, A1 (Continued)				
Y11	CRYSTAL, Series Resonant, 248 kHz	912200052	Sierra	A02452500	1
Y12	CRYSTAL, Series Resonant, 256 kHz	912200053	Sierra	A02452500	1
Y13	CRYSTAL, Series Resonant, 264 kHz	912200054	Sierra	A02452500	1
Y14	CRYSTAL, Series Resonant, 304 kHz	912200038	Sierra	A02368400	1
	OSCILLATOR ASSEMBLY, A1, Board	904500304	Sierra	C02454600	1
	SLOPE NETWORK, A2				
C1	CAPACITOR, Mica, 910 pF ±3%, 100VDCW	901900911	El Menco	C910H0100WV-4CR	2
C2	Same as C1				
C3	CAPACITOR, Mica, 2200 pF ±5%, 500VDCW	901900222	El Menco	DM19-222J	2
C4	Same as C3				
C5	CAPACITOR, Mica, 7500 pF ±3%, 100VDCW	901900752	El Menco	C7500	2
C6	CAPACITOR, Mica, 8200 pF ±2%, 100VDCW	901900822	El Menco	DM19-822G	2
C7	CAPACITOR, Mica, 9100 pF ±3%, 100VDCW	901900912	El Menco	C0100	2
C8	Same as C7				
C9	Same as C6				
C10	Same as C5				
L1	INDUCTOR, Variable, 134 µH (85T, L560-3F)		Sierra	A02368000 Red	2
L2	Same as L1				
L3	INDUCTOR, Variable, 310 µH (120T, L560-3F)		Sierra	A02367900 Green	2
L4	Same as L3				
L5	INDUCTOR, Variable, 38.4 µH (47T, L560-3F)		Sierra	A02368100 White	2
L6	Same as L5				
L7	INDUCTOR, Variable, 16.6 µH (28T, L560-3F)		Sierra	A02368200 Blue	2
L8	Same as L7				
R1	RESISTOR, Deposited Film, 1.21K ±1%, 1/2W	907400187	IRC	CEC	1
R2	RESISTOR, Deposited Film, 137Ω ±1%, 1/2W	907400188	IRC	CEC	2
R3	Same as R2				
R4	RESISTOR, Deposited Film, 15Ω ±1%, 1/2W	907400189	IRC	CEC	1
	SLOPE NETWORK, A2, Board	904500177	Sierra	C02365900	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MODULATOR/AMPLIFIER/POWER SUPPLY ASSEMBLY, A3				
C1	CAPACITOR, Ceramic, 0.1 µF +80 -20%, 50VDCW	901410104	Sprague	33C41	7
C2	Same as C1				
C3	CAPACITOR, Tantalytic, 22 µF ±20%, 15VDCW	902740226	Texas Instrument	SCM226BP0P5A4	3
C4	Same as C1				
C5	Same as C1				
C6	Same as C1				
C7	Same as C3				
C8	CAPACITOR, Mica, 270 pF ±5%, 500VDCW	901900271	El Menco	DM15-271-J	1
C9	Same as C3				
C10	Not Used				
C11	Same as C1				
C12	CAPACITOR, Mica, 120 pF ±5%, 500VDCW	901900121	El Menco	DM15-121J	1
C13	Same as C1				
C14	CAPACITOR, Mica, 82 pF ± 500VDCW	901900820	El Menco	DM15-820G	1
C15	CAPACITOR, Mica, 180 pF ±5%, 500VDCW	901900181	El Menco	DM15-F181J	1
C16	Not Used				
C17	Not Used				
C18	Not Used				
C19	Not Used				
C20	CAPACITOR, Mica, 1000 pF ±5%, 100VDCW	901920102	El Menco	DM15-102J	1
C21	CAPACITOR, Electrolytic, 1000 µF, 35VDC	902250108	Synchro	EMW 01946-A	1
CR1	DIODE, Germanium	910600191	Sylvania	1N191	4
CR2	Same as CR1				
CR3	Same as CR1				
CR4	Same as CR1				
CR5	DIODE, Silicon, 600V P.I.V. 750 mA	910800008	Diodes Inc.	DI-56	4
CR6	Same as CR5				
CR7	Same as CR5				
CR8	Same as CR5				
CR9	DIODE, Silicon	910500031	RCA	1N456	3
CR10	Same as CR9				
CR11	Same as CR9				
CR12	DIODE, Zener, 5.1V ±5%, 400 mW	910500076		1N751A	1
CR13	DIODE, Germanium		General Elect.	1N91	1
Q1	TRANSISTOR, Silicon, NPN	910300029	General Elect.	2N2924	2
Q2	Same as Q1				
Q3	TRANSISTOR, Silicon, NPN	910300012	RCA	2N696	2
Q4	Same as Q3				
Q5	TRANSISTOR, Silicon, PNP	910300037	Fairchild	2N3638	1
Q6	TRANSISTOR, Power, Silicon, NPN	910300057	RCA	40250	1
Q7	TRANSISTOR, Silicon, NPN	910300044		2N3641	1
Q8	TRANSISTOR, Silicon, NPN	910300046		2N3565	2
Q9	Same as Q8				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MODULATOR/AMPLIFIER/POWER SUPPLY ASSEMBLY, A3 (Continued)				
R1	RESISTOR, Composition, 27K ±5%, 1/4W	906900273	AB		1
R2	RESISTOR, Composition, 4.7K ±5%, 1/4W	906900472	AB		4
R3	Same as R2				
R4	RESISTOR, Composition, 100Ω ±5%, 1/4W	906900101	AB		3
R5	RESISTOR, Composition, 470Ω ±5%, 1/4W	906900471	AB		2
R6	RESISTOR, Composition, 12KΩ ±5%, 1/4W	906900123	AB		1
R7	Same as R2				
R8	RESISTOR, Composition, 180Ω ±5%, 1/4W	906900181	AB		1
R9	RESISTOR, Composition, 10Ω ±5%, 1/4W	906900100	AB		3
R10	Not Used				
R11	RESISTOR, Composition, 1.5KΩ ±5%, 1/4W	906900152	AB		1
R12	RESISTOR, Composition, Factory Select				2
R13	POTENTIOMETER, Wirewound, 200 Ω± 10%, 1/2 W	907900308			1
R14	Same as R9				
R15	Same as R9				
R16	RESISTOR, Composition, 1.2KΩ ±5%, 1/4W	906900122	AB		3
R17	RESISTOR, Composition, 3.3KΩ ±5%, 1/4W	906900332	AB		2
R18	Same as R4				
R19	Same as R4				
R20	Same as R5				
R21	Same as R4				
R22	RESISTOR, Composition, 33Ω ±5%, 1/4W	906900330	AB		1
R23	RESISTOR, Composition, 10Ω ±10%, 1W	905600100	AB		1
R24	RESISTOR, Prec. Film, 78.7KΩ ±1%, 1/8W		Electra	MF-5C	1
R25	RESISTOR, Composition, 3.9KΩ ±5%, 1/4W	906900392	AB		1
R26	Same as R17				
R27	Same as R16				
R28	RESISTOR, Wirewound, 5Ω ±5%, 3-1/4W		Ohmite	#4349	1
R29	Same as R2				
R30	POTENTIOMETER, Wirewound, 2KΩ	907900228	Beckman	62PAR2K	1
R31	RESISTOR, Composition, 2.7KΩ ±5%, 1/4W	906900272	AB		2
R32	Same as R31				
R33	RESISTOR, Composition, 2.2KΩ ±5%, 1/4W	906900222	AB		1
R34	RESISTOR, Composition, 1.8KΩ ±5%, 1/4W	906900182	AB		1
R35	Same as R16				
T1	TRANSFORMER, 1 CT: 1 CT, 10 mH, 0.C.L.	909900015	Pulse Eng.	P.E. 5163	4
T2	TRANSFORMER, 2 CT: 1 CT, 25 mH, 0.C.L.	909900020	Pulse Eng.	P.E. 5919	1
T3	Same as T1				
T4	Same as T1				
T5	Same as T1				
Z1	LOW-PASS FILTER, 600Ω: 600Ω Pass 36-140 kHz Within 0.25 dB, Stop 164 kHz and up to 35 dB	910100052	Hi-Sonic Inc.	#20-0102-00	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MODULATOR/AMPLIFIER/POWER SUPPLY ASSEMBLY, A3 (Continued)				
	TRANSISTOR, Socket	914200036			2
	CLIP, Transistor Retainer	916900019			2
	MODULATOR/AMPLIFIER/POWER SUPPLY ASSEMBLY, A3, Board	904500305	Sierra	C02675600	1
	LEVEL AMPLIFIER, A4				
C1	CAPACITOR, Tantalytic, 22 µF, ±20%, 15VDCW	902740226	Texas Inst.	SCM226BP0P5A4	1
C2	CAPACITOR, Ceramic, 0.1 µF, +80 -20%,50V	901410104	Sprague	33C41	5
C3	Same as C2				
C4	CAPACITOR, Electrolytic, 1.0 µF, 25VDCW	903300105	Nashville	8-250BP1-25S85-NP	1
C5	Same as C2				
C6	Same as C2				
C7	Same as C2				
C8	CAPACITOR, Tantalum, 180 µF ±10%, 6VDCW	902700187	Sprague	150D187X9006R2	1
C9	CAPACITOR, Mica, 820 pF ±5%, 500V	901900821	El Menco	DM15-821J	1
CR1	DIODE, Germanium	910600191	General Ind.	1N191	2
CR2	Same as CR1				
L1	INDUCTOR, RF, 10 mH ±5%	909000134	Miller	70F102A1	1
Q1	TRANSISTOR, Silicon, NPN	910300029	General Elec.	2N2924	2
Q2	Same as Q1				
R1	RESISTOR, Composition, 10KΩ ±5%, 1/4W	906900103	AB		1
R2	RESISTOR, Deposited Film, 3.99K ±1%, 1/2W	907400156	Electra		1
R3	POTENTIOMETER, Wirewound, 1KΩ ±10%,1/2W	907900209	Bourns	3067P-1-102	1
R4	RESISTOR, Composition, 27KΩ ±5%, 1/4W	906900273	AB		1
R5	RESISTOR, Composition, 4.7K ±5%, 1/4W	906900472			1
R6	RESISTOR, Composition, 5.6KΩ ±5%, 1/4W	906900562			2
R7	RESISTOR, Composition, 330Ω ±5%, 1/4W	906900331			1
R8	RESISTOR, Composition, 3.9KΩ ±5%, 1/4W	906900392			1
R9	Same as R6				
R10	Not Used				
R11	RESISTOR, Composition, 1.8KΩ ±5%, 1/4W	906900182			2

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	LEVEL AMPLIFIER, A4 (Continued)				
R12	RESISTOR, Composition, 560Ω ±5%, 1/4W	906900561			1
R13	RESISTOR, Composition, 150Ω ±5%, 1/4W	906900151			1
R14	RESISTOR, Composition, 220Ω ±5%, 1/2W	906900221			2
R15	Same as R14				
R16	Same as R11				
	LEVEL AMPLIFIER, A4, Board		Sierra	C02675800	1
	SLOPE SWITCH ASSEMBLY				
R1	RESISTOR, Deposited Film, 2870Ω, ±1%, 1/2W	907400190			1
R2	RESISTOR, Deposited Film, 2180Ω, ±1%, 1/2W	907400074			1
R3	RESISTOR, Deposited Film, 1210Ω, ±1%, 1/2W	907400187			1
R4	RESISTOR, Deposited Film, 1KΩ, ±1%, 1/2W	907400080			1
R5	RESISTOR, Deposited Film, 600Ω, ±1%, 1/4W	908300001			1
R6	RESISTOR, Deposited Film, 374Ω, ±1%, 1/2W	907400195			1
R7	RESISTOR, Deposited Film, 246Ω, ±1%, 1/2W	907400111			1
R8	RESISTOR, Deposited Film, 147Ω, ±1%, 1/2W	907400198			2
R9	RESISTOR, Deposited Film, 121Ω, ±1%, 1/2W	907400209			2
R10	RESISTOR, Deposited Film, 75.0Ω, ±1%, 1/4W	908300071			2
R11	RESISTOR, Deposited Film, 56.2Ω, ±1%, 1/2W	907400200			1
R12	RESISTOR, Wirewound, 7.5Ω, ±1%, 3W	906100102	Ohmite	Type 884	1
R13	RESISTOR, Deposited Film, 10.1Ω ±1%, 1/2W	907400100			1
R14	RESISTOR, Deposited Film, 16.0Ω, ±1%, 1/2W	907400069			1
R15	RESISTOR, Deposited Film, 19.1Ω, ±1%, 1/2W	907400203			1
R16	RESISTOR, Deposited Film, 31.6Ω, ±1%	907400216			1
R17	RESISTOR, Deposited Film, 47.5Ω, ±1%, 1/2W	907400206			1
R18	Same as R10				
R19	Same as R9				
R20	Same as R8				
R21	RESISTOR, Deposited Film, 222Ω ±1%, 1/2W	907400142			1
R22	RESISTOR, Deposited Film, 316Ω ±1%, 1/2W	907400211			1
S14	SWITCH, Rotary, 4 Pole, 11 Position, Shorting	911200130	CTS	A02202200	1
	OUTPUT ATTENUATOR				
R1	RESISTOR, Precision Film, 68.47Ω ±1%, 1/2W	907400146			4
R2	RESISTOR, Precision Film, 1.01 KΩ ±1%, 1/2W	907400149			1
R3	RESISTOR, Precision Film, 5.62 KΩ ±1%, 1/2W	907400217			2
R4	Same as R3				
R5	Same as R1				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	OUTPUT ATTENUATOR (Continued)				
R6	RESISTOR, Precision Film, 1370Ω ±1%, 1/2W	907400218			1
R7	RESISTOR, Precision Film, 1740Ω ±1%, 1/2W	907400219			2
R8	Same as R7				
R9	Same as R1				
R10	RESISTOR, Precision Film, 69.8Ω ±1%, 3 Watt	906100141	Ohmite	884-3	6
R11	Same as R10				
R12	RESISTOR, Precision Film, 6190Ω ±1%, 1/2W	907400220			2
R13	Same as R12				
R14	Same as R1				
R15	Same as R10				
R16	Same as R10				
R17	RESISTOR, Precision Film, 1.85KΩ ±1%, 1/2W	907400167			2
R18	Same as R17				
R19	Same as R10				
R20	Same as R10				
R21	RESISTOR, Precision Film, 10.5KΩ ±1%, 1/2W	907400221			1
S20	SWITCH, Rotary, 8 Position	911200146	Sierra	A02605400	1
	PANEL ASSEMBLY				
C1	CAPACITOR, Tantalytic, 22 µF ±20%, 15VDCW	902740226	Texas Instru.	SCM226BP0P5A4	3
C2	Same as C1				
C3	Same as C1				
DS1	LAMP CARTRIDGE, Neon	913800019	Dialco		1
	CLIP For DS1	917300213	Dialco	7538 x P51	1
	SOCKET For DS1	914200033	Dialco	7538 x P50	1
F1	FUSE, 3 AG, 1/10A, Slow Blow	913200034	Littelfuse	313.100	1
J1	CONNECTOR, 20 Pin Male, Similar to KS-14160 L1	914800003	Cinch	213-20-00-116	1
J2	RECEPTACLE	914800077	Tower	H1061	1
M1	METER, Rectangular, 3-1/2", 0-200 µA	911800111	Sierra	A02454200	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	PANEL ASSEMBLY (Continued)				
R1	POTENTIOMETER, Panel Mount, Knurled Shaft, 500Ω ±10%	907900286	Dale	2185-108	14
R2	Same as R1				
R3	Same as R1				
R4	Same as R1				
R5	Same as R1				
R6	Same as R1				
R7	Same as R1				
R8	Same as R1				
R9	Same as R1				
R10	Same as R1				
R11	Same as R1				
R12	Same as R1				
R13	Same as R1				
R14	Same as R1				
R15	RESISTOR, Deposited Film, 2K ±½%, 1/2W	907400222	IRC	CEC	13
R16	Same as R15				
R17	Same as R15				
R18	Same as R15				
R19	Same as R15				
R20	Same as R15				
R21	Same as R15				
R22	Same as R15				
R23	Same as R15				
R24	Same as R15				
R25	Same as R15				
R26	Same as R15				
R27	RESISTOR, Composition, 560Ω ±5%, 1/2W	905000561	AB	EB	1
S1	SWITCH, Toggle, SPST, Bat. Handle	911000002	A.H. & H.	20994-LH	13
S2	Same as S1				
S3	Same as S1				
S4	Same as S1				
S5	Same as S1				
S6	Same as S1				
S7	Same as S1				
S8	Same as S1				
S9	Same as S1				
S10	Same as S1				
S11	Same as S1				
S12	Same as S1				
S13	Same as S1				
S14	(SLOPE SWITCH ASSY.)				1
S15	SWITCH, Slide, DPDT Marked 115/230	911000040	Switchcraft	46256LF	1
S16	SWITCH, Rotary, 14 Position	911200145	Sierra	A02605300	1
S17	SWITCH, Toggle, DPDT, Bat. Handle	911000001	A.H. & H.	20905 FR	2
S18	Same as S17				
S19	SWITCH, Push Button, Momentary	911300002	A. H. & H.	3392	1
S20	(OUTPUT ATTENUATOR ASSY.)				1
S21	SWITCH, Rotary (Special) Frame	911200084	Sierra	SS-14827-1	1
	Wafers		CTS	T-5	3

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	PANEL ASSEMBLY (Continued)				
T1	TRANSFORMER, Power, 115/230VAC:15VAC, 300 mA	910000103	Sierra	A02638400	1
XF1	FUSE HOLDER, 3 AG	913400014	Littelfuse	342004	1
	POST, Binding, Non-Insulated Black	915200012	General Radio	938-C	4
	POST, Binding, Black Insulator Pair	915200014	General Radio	938 B	4 Pr.
	POST, Binding, Metal Top	915200013	General Radio	938 A	2
	KNOB, Black Pointer	916000035	Raytheon	70-4-2-G	4
	SPACER	915200011	General Radio	938 F	2
	HANDLE	918100027	Sierra	A02368800	2
	FERRULE	921200088			4
	LOCKING RING		Cutler Hammer	#29-761	16
	CASE AND COVER ASSEMBLY				
	GROMMET, (Nylatch)	917300159	Hartwell	H322-3-1	2
	PLUNGER, (Nylatch)	917300346	Hartwell	H323-3-1-1	2
	BATTERY HOLDER, For 6 "D" Cells	921100016	Keystone Elec.	#201	2
	POLARIZING RING	921100006	Keystone Elec.	#59	6
	SHIELDED DOUBLE PLUG		General Radio	#274-NK	1
	CABLE CLAMP, Nylon	915300020			1
	CABLE, Power, 3 Conductor, 6 Ft.	916400019	Beldon	17258	1

PHILCO Ford

PHILCO-FORD CORPORATION
Sierra Electronic Operation
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Warranty

SIERRA ELECTRONIC OPERATION, PHILCO-FORD CORPORATION warrants instruments manufactured by it and bearing Sierra commercial model numbers, except Infrared Cells, to be free from defective material and factory workmanship and agrees to repair such instruments, which under normal use and service, disclose the defects to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing any such instrument which in our sole opinion upon our examination proves to be so defective, when returned to our factory at 3885 Bohannon Drive, Menlo Park, California 94025, transportation prepaid by the purchaser, within one year from the date of original purchase from us.

This warranty does not apply to any products which have been repaired, worked upon or altered by persons not authorized by us so as, in our sole judgement, to injure the stability or reliability of such instrument, or which have been subject to misuse, negligence or accident, or the serial number of which has been altered, effaced, or removed. Neither does this warranty apply to any of our products which have been connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by us. Nor does SIERRA assume any liability for consequential damages, and in any event our liability shall in no case exceed the original purchase price of the instrument. Accessories, including but not limited to all vacuum tubes, fuses and batteries, not of our manufacture used with this product are not covered by this warranty.

SIERRA reserves the right to make changes in the design or construction of any of its instruments at any time without incurring any obligation to make any changes whatever on units previously purchased.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to represent nor assume for us any liability in connection with the sale of our products other than set forth herein. In no event will seller be liable for any incidental or consequential damages.

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